

Claims

What is claimed is:

1. A density meter for determining the density of at least one fluid within a pipe, said density meter comprising:
  - a first sound speed meter positioned at a first sensing region along said pipe which provides a first system effective sound speed signal;
  - a second sound speed meter positioned at a second sensing region along said pipe which provides a second system effective sound speed signal;
  - a signal processor, responsive to said first and said second system sound speed signals, which provides a density signal indicative of said density of said fluid pipe.
2. The apparatus of claim 1 wherein said first sensing region has a first cross sectional compliance and wherein said second sensing region has a second cross sectional compliance and wherein said first cross sectional compliance is substantially different from said second cross sectional compliance.
3. The apparatus of claim 1 wherein the compliance of said pipe is different in each of said sensing regions.
4. The apparatus of claim 1 further comprising a concentric shell positioned around each of said first and said second sound speed meters thereby isolating said first and said second sound meters from an outside environment.
5. The apparatus of claim 1, wherein said first and said second sound speed meters determine said first and said second system sound speeds from one-dimensional acoustic pressure waves traveling along said pipe.
6. The apparatus of claim 1 wherein said at least one of said first and said second sound speed meters comprises a fiber optic based sound meter.

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7. The apparatus of claim 2 wherein said first or said second sensing region of said pipe comprises a non-circular cross sectional geometry.
8. The apparatus of claim 7 wherein said non-circular cross sectional geometry comprises an oval shape.
9. The apparatus of claim 2 further comprising an input line positioned between said first and said second sensing regions to provide a known quantity of a known substance into said fluid.
10. A method for measuring the density of a fluid within a pipe, the method comprising:
  - a) measuring a first effective system sound speed at a first sensing region along said pipe and providing a first effective system sound speed signal;
  - b) measuring said a second effective system sound speed a second sensing region along said pipe and providing a second effective system sound speed signal; and
  - c) calculating said density using said first and said second effective system sound speed signals.
11. The method of claim 10, wherein said calculating step (c) comprises:
  - d) subtracting said first and said second effective system sound speeds to obtain a difference related to a compliance difference between said two sensing regions.
12. The method of claim 10 wherein said measuring steps (a) and (b) comprise measuring a propagation velocity of a one-dimensional acoustic pressure wave traveling along said pipe.
13. The method of claim 10 wherein said step of measuring said first and said second effective system sound speeds comprises measuring a strain of the pipe.